Some Aspects of the Biology of *Terebra dislocata* Say, 1822

(Gastropoda : Prosobranchia)

BY

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INTRODUCTION

Terebra dislocata Say, 1822 is a common gastropod in the area of Beaufort, North Carolina, where it is found in quantity in the tidal pools on exposed sand flats. The range of the species extends from Virginia to Texas and the Virgin Islands; the species is perhaps most abundant in Florida (Morris, 1960). The animals are often found at the head of a V-shaped furrow they leave behind, or in the castings left by the hemichordate *Balanoglossus aurantiacus* (Girard, 1853). The shell of *T. dislocata* is a grayish brown or yellowish white, $2\frac{1}{2}$ to 5 cm in length, with a surface sculptured by wavy longitudinal folds and spiral grooves.

Despite the ready availability for study of this species, a search of the literature uncovered no references dealing with the biology of this gastropod. This paper seeks to present preliminary information on several aspects of the biology of *Terebra dislocata*. Future studies of a more specific nature will hopefully answer some of the questions raised.

LOCOMOTION

Probably as a result of the length of the shell, *Terebra dislocata* drag it behind them as they move. Usually they travel buried just below the sand surface with the siphon extended into the overlying water, but they may be found also at the surface. The broad foot apparently has a direct, monotactic movement which is continuous, whereas the shell is moved discontinuously. Increased tension on the pedal retractor muscles, caused by shell drag, evidently must stimulate them to pull the shell forward. The shell is supported by the substrate during horizontal movement, even on glass. However, *T. dislocata* are apparently not able to furnish the torque necessary to lift the long shell over an edge, and they therefore seldom escape from open glass containers.

FOOD HABITS

Examination of the stomachs of 35 specimens gathered in the sand flats near Beaufort in August of 1971 and preserved in the field failed to uncover a single food particle. The Terebridae are commonly thought to have poison glands and a radula (Kaestner, 1967) and are said to be carnivorous in habit, existing on such prey as polychaetes (Hyman, 1967). However, laboratory studies utilizing tissue smashes of the digestive system were unable to detect a radula. In fact, *Terebra dislocata* would not feed in the laboratory when offered a variety of food types, including polychaetes and clam meat. Their common occurrence in the castings of *Balanoglossus* suggests another mode of feeding. It may be that these castings constitute the most concentrated source of organic detritus available on the sand flat surface, and that the snails exploit this food source, which would account for the high degree of association previously mentioned. The absence of carnivorous feeding habits and structures noted may rule out direct feeding upon *Balanoglossus*.

The absence of carnivorous feeding habits and structures is not unusual in the Terebridae. In a discussion comparing 6 terebrid species (*Terebra dislocata* not included), Rudman (1969) found half of them to lack radular teeth and poison glands. He divided the Terebridae into two general groups: those with a foregut similar to cones with poison glands and radulae, and those lacking these structures. *Terebra dislocata* belongs in the second category, but a more thorough examination of feeding structures is necessary in order to ascertain the exact mode of feeding.

REACTIONS TO ENVIRONMENTAL FACTORS

The twice daily tidal exposure of the sand flats subjects *Terebra dislocata* to several possible major changes in physical environmental factors. The animals may either tolerate or avoid these hardships, and several experiments were designed to determine their reactions to several of these environmental changes.

Light: Because of the burrowing behavior of *Terebra dislocata* it was hypothesized that this species may exhibit an avoidance reaction to light. The following experiment was used to test this hypothesis. A rectangular pan 30 cm by 60 cm was sprinkled with sand to a depth of 2 cm; water was added to a depth of 3 cm above the sand layer. Ten specimens were placed in an even distribution throughout the pan and half the pan was placed in the shade. At 1½ hour intervals from noon until midnight, the locations of the animals were recorded. The control consisted of a pan arranged as before, but with full illumination. A Chi-square equality analysis ($X^2_{1df} = 6.0$, $p < 0.05$) showed a significant preference for the darkened half of the pan at all hours, while the control distribution did not differ significantly from random expectation ($X^2_{1df} = 0.46$, $p > 0.05$). It is significant that *T. dislocata* did not completely avoid the light, since in nature the animals are found on the surface during the day. However, at night their abundance at the surface is markedly increased. This may indicate that part of the population exploits food resources not available during the night, but no evidence is available to support this hypothesis.

Salinity: Salinity in the tide pools may vary extremely, becoming greater if the water evaporates rapidly, and decreasing if rain dilutes the water in the pools. The reaction of *Terebra dislocata* to decreased salinity was tested by placing 5 specimens in each of five 8½ inch diameter glass bowls which contained sand saturated with 100% seawater. A 3 cm water layer above the sand was diluted with distilled water to 75%, 50%, 25%, and 0% seawater, with 100% seawater serving as a control. All bowls were at room temperature (27° C). The animals in water diluted to 50% seawater or less remained motionless with tightly closed shells. Of the specimens in 75% seawater, one burrowed partially and the others extended their siphons. The specimens in the control group behaved normally, with most burrowing into the sand. All the animals were left at least 8 hours under experimental conditions, and those in 0% seawater were left 12 hours; all survived.

These results indicate that *Terebra dislocata* is not physiologically stressed by reduced salinities at times of low tide even on a rainy day. Behavior was normal at the two higher salinities and *T. dislocata* avoided the lower salinities by retreating into its shell. Avoidance of low salinities could also have been accomplished by burrowing into the saturated sand, but this means of escape was not chosen. However, it may be that the salinity became equalized. Present knowledge of the salinity tolerances of intertidal prosobranchs reveals two basic patterns: a rather narrow tolerance in those existing in areas of stable salinities and a wide tolerance in other groups (Arnold, 1972). Since *T. dislocata* lives in areas where heavy rains may rapidly reduce salinities in tidal pools, it might be placed in the latter group. However, since different populations of the same molluscan species may exhibit strikingly different salinity tolerances dependent upon their location in the intertidal area (Arnold, 1957), further studies are needed in order to determine the specific nature of *T. dislocata*'s salinity tolerances and osmoregulatory ability.

Desiccation: A very low spring tide may leave *Terebra dislocata* stranded outside the usual tidal pools. Their reactions to such conditions were tested by placing 5 specimens in each of three 8½ inch diameter glass bowls containing damp sand, seawater saturated sand, and sand with a 3 cm supernatant seawater layer. To remove the possibility of light avoidance burrowing, the bowls were placed in the shade. After 4 hours, the animals in the first 2 bowls were on the surface extended from their shells, while those in the seawater exhibited normal burrowing behavior. Since other prosobranchs have been known to resist desiccation for weeks or months by tightly closing the operculum (Colgon cited in Newell, 1970), the type of behavior exhibited by *T. dislocata* in the first 2 experimental conditions seems non-adaptive. However, it is not unusual when compared to other gastropods atypically exposed by low tides. Gowanloch (cited in Newell, 1970) reported on the absence of operculum closure in a sublittoral whelk, and Lewis (1964) reported how an upper shore species of *Littorina* closed the operculum while a lower shore species remained extended. These examples illustrate the influence of habitat, and the influence of physiological and behavioral patterns of organisms on their distributions.

SUBSTRATE PREFERENCE

Field observations indicated that adult *Terebra dislocata* were found only within the top sand layer of the Beaufort sand flat, the flat itself being composed of two sand layers (an upper light colored layer approximately 3 cm thick, and a lower one of dark anaerobic sand). An experiment was designed to determine whether the adult animals exhibit a substrate preference resulting in their distribution.

Four substrate types were collected from the field: open beach sand, marsh mud, upper-layer (sand flat) sand, and bottom-layer (sand flat) sand. Each was placed in a 3 cm thick wedge occupying one-fourth the area of a circular pan 75 cm in diameter. Seawater was slowly introduced in order to prevent disturbance of the substrates, and 6 specimens were placed on each substrate type. Counts of the locations of the animals were made at $1\frac{1}{2}$ hour intervals for a period of 9 hours, ending at midnight. A control consisted of a single substrate type, the top-layer sand, in an identical circular pan. Results showed that about 50% of the animals preferred upper-layer sand, while the others were somewhat evenly distributed on the other substrates. A Chi-square analysis ($X^2_{1df} = 45.0$, $p < 0.05$) showed a significant preference for the upper-layer sand when compared to the other substrate types, while the control distribution did not differ significantly from random expectation ($X^2_{3df} = 1.22$, $p > 0.05$). The specific reasons for the preference have not been determined, but it was not surprising to find a preference for the substrate on which the animals are usually found. The results indicate that all substrates are somewhat acceptable and that other factors may influence distribution more directly, such as oxygen or food availability.

CONCLUSIONS

The above observations and experiments introduce an animal which superficially appears to be well adapted to its environment. The experiments on orientation with respect to environmental variables indicate that its survival is probably not reduced by any one of the factors tested. However, a combination of factors might stress *Terebra dislocata* enough to cause significant mortality. In all areas investigated, further work is necessary in order to ascertain the specific mechanisms behind the behavioral patterns exhibited.

SUMMARY

Terebra dislocata is a common gastropod in the area of Beaufort, North Carolina. Despite its ready availability for research, no references were uncovered which dealt with the biology of this species. Preliminary information on several aspects of the biology of *T. dislocata* is presented.

Examination of the stomachs of 35 specimens failed to uncover a single food item, although the literature suggests a carnivorous feeding habit. Laboratory studies were unsuccessful in revealing a radula, and it was suggested that *Balanoglossus* castings may serve as a food source. *Terebra dislocata* was found to avoid light; it is known to be especially abundant on the sand flats at night. This probably has some ecological significance not yet discovered. Effects of reduced salinities were tested, and specimens of *T. dislocata* were able to avoid the lowest concentrations of seawater by closing their shells. They reacted to desiccation experiments by remaining exposed, which appears to be non-adaptive. However, this type of behavior is not unusual for gastropods atypically exposed at low tides. Substrate preference tests showed that *T. dislocata* clearly preferred the sand type upon which it is normally found. The specific reasons for this preference have yet to be determined.

ACKNOWLEDGMENTS

I would like to thank the Duke University Marine Invertebrate class (Summer 1971) of Dr. Robert Barnes for contributing some data, and Dr. Robert Edwards of Christopher Newport College for reading and criticizing this manuscript.

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